

UNITED REPUBLIC OF TANZANIA
MINISTRY OF TRANSPORT



AIRCRAFT ACCIDENT AND INCIDENT
INVESTIGATION BRANCH
TANZANIA

CIVIL AIRCRAFT ACCIDENT No. CAV/ACC/6/22

FINAL REPORT ON THE ACCIDENT TO ATR 42-500 AIRCRAFT REGISTRATION
5H-PWF WHICH OCCURRED ON 6 NOVEMBER 2022 IN LAKE VICTORIA NEAR BUKOBA AIRPORT

Civil Aircraft Accident No. CAV/ACC/6/22

Aircraft type:	ATR 42-500
Nationality and Registration Marks:	5H-PWF
Place of Accident:	Lake Victoria, 500 meters short of threshold of runway 31 of Bukoba Airport
Date of Accident:	6 November 2022
Time:	0543.35 hours (0843.35 hours Local Time)
Operator:	Precision Air PLC
Type of flight:	Scheduled Commercial flight
Numbers on board:	Crew: 4 Passengers: 39
Injuries:	Crew: 2 (fatal) Passengers: 17 (fatal)
Damage to aircraft:	Damaged beyond economic repair
Commander's age and License:	64 years, ATPL
Commander's total flying experience:	23,515 hours of which 11,929 were on type
First Officer's age and license:	45 years, CPL
First Officer's total flying experience:	2,109 hours of which 1,700 were on type
Aircraft total time:	16,843 hours
Aircraft total cycles:	23,267 cycles

ALL TIMES UTC

FOREWORD

This final report is produced by the Aircraft Accident Investigation Branch (AAIB), Ministry of Transport, Tanzania.

The report is based on the investigation carried out by the Tanzania Aircraft Accident Investigation Branch (AAIB), in accordance with Annex 13 to the Convention on International Civil Aviation, Tanzanian Civil Aviation Act (CAP 80) and the Civil Aviation (Aircraft Accident and Incident Investigation) Regulations 2017.

In accordance with Annex 13 to the Convention on International Civil Aviation, it is not the purpose of aircraft accident/serious incident investigations to apportion blame or liability.

The purpose of this report is to provide details of facts, discussions and findings surrounding the occurrence; it includes information gathered from witness statements, inspection of the accident site and aircraft as well as analysis and safety recommendations.

Readers are advised that the AAIB Tanzania investigates for the sole purpose of enhancing aviation safety. Consequently, AAIB reports are confined to matters of safety significance and should not be used for any other purpose.

AAIB Tanzania believes that safety information is of great value if it is passed on for the use of others hence, readers are encouraged to copy or reprint for further distribution, acknowledging the AAIB as the source.

ACKNOWLEDGEMENT

Aircraft Accident Investigation Branch (AAIB) Tanzania acknowledges with profound gratitude the dedicated involvement of BEA of France, Aircraft Manufacturer (ATR), Operator (Precision Air), Engine Manufacturer (Pratt & Whitney of Canada), Kenya AAID, UK AAIB, Canada TSB, Tanzania Airport Authority (TAA) and Tanzania Civil Aviation Authority (TCAA) in the investigation process.

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GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

AAIB	Aircraft Accident Investigation Branch
AAID	Aircraft Accident Investigation Department in Kenya
AOC	Air Operator Certificate
ATPL	Airline Transport Pilot Licence
AVSEC	Aviation Security
BEA	BEA Bureau d'Enquête et d'Analyse pour la sécurité de l'aviation civile (French Safety Investigation Authority)
CB	Cumulonimbus – Heavy and dense cloud of considerable vertical extent
CoA	Certificate of Airworthiness
CRM	Crew Resource Management
CRS	Certificate of Release to Service
CSO	Cycles Since Overhaul
CVR	Cockpit Voice Recorder
daN	DecaNewtons
EASA	European Aviation Safety Agency
EGPWS	Enhanced Ground Proximity Warning System
ELT	Emergency Locator Transmitter
DFDR	Digital Flight Data Recorder
FL	Flight Level
F/O	First Officer (Co-pilot)
GPS	Global Positioning System
HF	High Frequency
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
MLG	Main Landing Gear
N/A	Not Applicable
NLG	Nose Landing Gear

PA	Public Address
PBN	Performance Based Navigation
PIC	Pilot In Command
PF	Pilot Flying
P/N	Part Number
S/N	Serial Number
QNH	Quarry Navigation Height –The barometric altimeter setting that causes an altimeter to read airfield elevation above mean sea level when on the airfield.
RA	Radio Altitude (Altitude Above Ground Level)
TSB	Transportation Safety Board of Canada
VFR	Visual Flight Rules

SYNOPSIS

On 6 November 2022 at 0543:38 hours (0843:38 hours Local Time), Precision Air Flight Number 494, an ATR 42 - 500 aircraft with registration 5H-PWF crashed in Lake Victoria while approaching to land on runway 31 of Bukoba Airport, Kagera Region, United Republic of Tanzania. During the approach it encountered heavy rain and thunderstorms with lightning as well as significant crosswind and turbulence.

During the final approach, several nose down inputs on the control column increased the descent rate of the aircraft. The EGPWS SINK RATE-SINK RATE alert triggered 15 seconds before the accident. Then the EGPWS PULL-UP warning triggered, followed by flight crew's nose up input on control column, around 2 seconds before the aircraft struck the water surface of Lake Victoria about 500 meters short of runway 31 threshold.

The impact with the water caused significant damage to the aircraft fuselage followed by water entering the cabin and flightdeck. There was no fire but the aircraft was damaged beyond economic repair. Of the 43 persons on board, 17 passengers and 2 pilots lost their lives while 22 passengers and 2 cabin crewmembers survived without serious injuries.

It is considered that conducting an unstabilized final approach in poor weather conditions that could not allow clear visual contact with the ground was a major factor in this accident. The decision of the Pilot in Command to negotiate his way through the narrow weather window in order to reach the runway, the high crew workload caused by the presence of thunderstorms, the variable cross wind, rain and turbulence as well as the absence of air traffic services at Bukoba airport were contributory factors.

1 FACTUAL INFORMATION

1.1 History of the flight

On 6 November 2022 at 0310 hours (0610 hours Local Time), Precision Air ATR 42-500 aircraft with registration 5H-PWF, flight number PW 494 took-off from Julius Nyerere International Airport, Dar es Salaam for a scheduled commercial passenger flight to Bukoba. The subsequent destinations were Mwanza and Dar es Salaam. It was carrying a crew of four including two pilots and two cabin crewmembers as well as 39 passengers, one of whom was an infant. The estimated time of arrival at Bukoba was 0525 hours (0825 hours Local Time). The Pilot in Command (PIC) was the pilot flying. The aircraft was flying under Instrument Flight Rules (IFR).

Much of the flight to Bukoba was uneventful, cruising at Flight Level (FL) 200. The flight reached top of descent at 0458 hours (0758 hours Local Time) when the flight crew initiated descent to FL 160.

At 0504 hours (0804 hours Local Time) there was a public address announcement of expected landing at Bukoba at 0526 hours (0826 hours Local Time). Nine minutes later Mwanza Approach advised the flight crew that the weather at Bukoba was fairly good with “wind calm”, “visibility better than 10 km” “partly cloudy” SCT 011, FEW013 CB, BROKEN 080, T21/17 and QNH 1018. However, as the flight progressed the crew started to experience signs of poor weather conditions. In their discussion they pointed out that they may have to approach the airport from the mountains (i.e. runway 13) if Bukoba remained below the clouds.

At 0519:32 hours the crew reported to Mwanza Approach to have Bukoba in sight¹ and were cleared to change to unmanned frequency of 118.2 MHz. It was at this time the flight crew initiated a visual approach.

At 0524:01 hours the crew encountered bad weather over KEMONDO bay and decided that they were going to land on runway 13 (from the mountains on the mainland).

At 0525:25 hours the PIC said to the First Officer (F/O) “Look for the runway”. Indeed in a span of one minute he gave this instruction three times. The F/O responded “I am looking”.

At 0525:45 hours the flaps were lowered to 15 degrees followed by the landing gear extension 7 seconds later. At this time the runway was not visible according to the conversation between the

¹ Crew had seen the Bukoba airport

pilots. The PIC then decided that they should descend to 5,000 ft. Lake Victoria is 3,720 ft above mean sea level.

The landing checklist was performed at 0526:59 hours. Subsequent to this, and as the runway was still not visible, the flight crew decided not to land and instead climbed to 5500 ft. The auto pilot was disengaged, the flaps were retracted to zero degrees and the landing gear was retracted.

At 0529:35 hours the PIC transferred control to the F/O. The crew also started a discussion about the minimum fuel required for a flight from Bukoba to Mwanza. The F/O suggested a diversion to Mwanza would be appropriate but the PIC opted to continue circling around.

At 0533:24 hours the PIC instructed the F/O to go to Kemonondo and try again. This was followed by a Public Address (PA) from the PIC to inform the passengers that they could not land at Bukoba due to heavy rain and they had to wait until the weather improved. If not, they would proceed to Mwanza.

At 0533:33 hours the selected altitude was changed from 5500 ft to 5300 ft, the aircraft descended to 5300ft.

At 0534:43 hours, at around 1,100 ft RA, the Enhanced Ground Proximity Warning System (EGPWS) warning "TERRAIN, TERRAIN PULL UP" triggered. However, the warning was not followed by corrective action of the flight crew. The crew continued to discuss about the weather and initiated contact with Precision Air Bukoba load control² (on a mobile phone) that weather information had been transmitted to Mwanza Approach. Furthermore the Bukoba load control informed the crew about the advice from Bukoba MET that they should wait for 20 minutes for the weather to normalise.

The crew continued to encounter storms and heavy rain as they proceeded to Kemonondo. They subsequently decided to descend to 4900 ft..

At 0539:56 hours the PIC asked the F/O to confirm if he had seen Musila Island. The F/O confirmed to have seen it. However, in a span of 78 seconds the flight crew was trying to locate Musila Island to no avail.

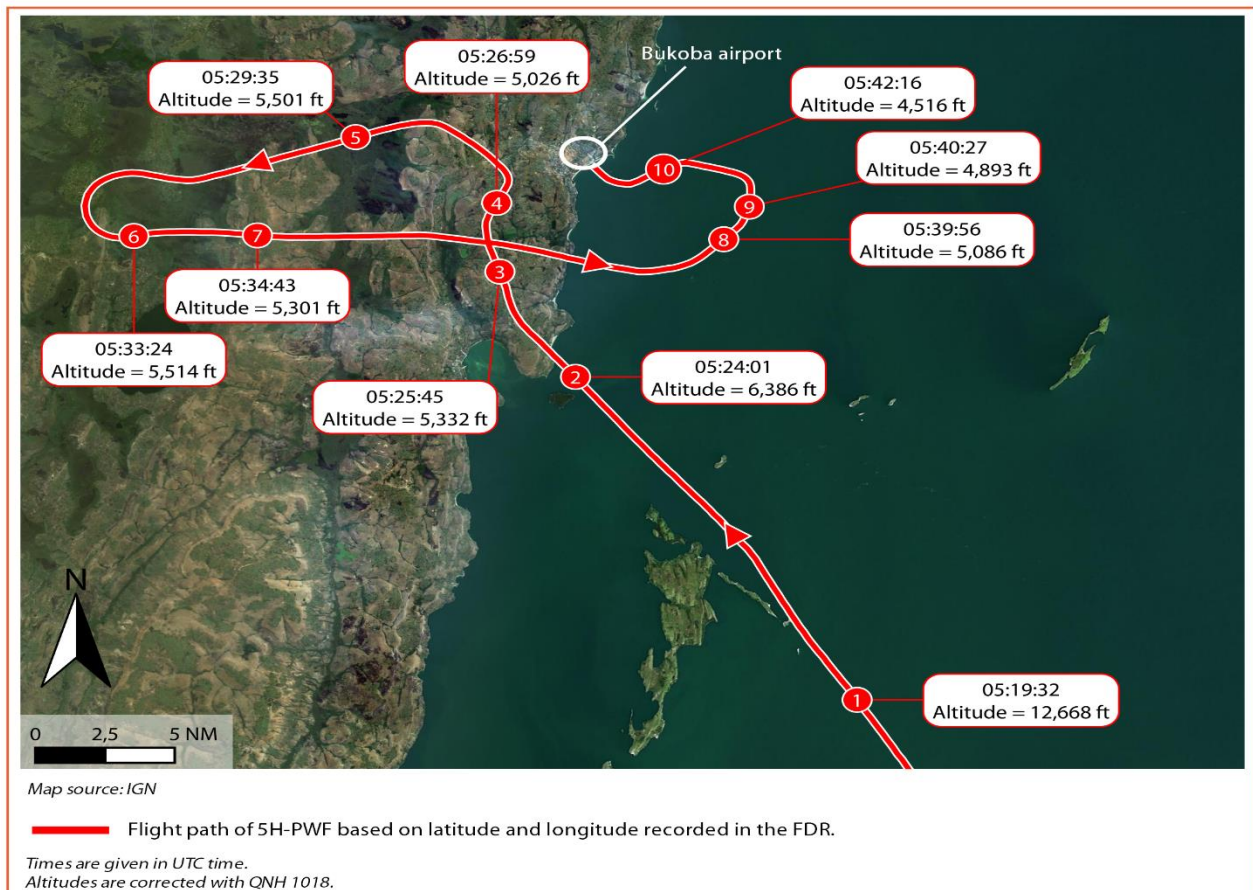
At 0540 hours the flaps were deployed to 15 degrees, the landing gear was extended, the vertical speed was selected to -1,000 ft/min and 4,500 feet altitude was selected.

At 0541 hours Flap 25 degrees was selected followed by Full flaps (35 degrees) and the PIC called "speed 102" which was acknowledged by the F/O. A few seconds later the PIC cautioned the F/O

² Precision Air handling agent

: “watch your speed, speed, speed, need power, a lot of power”. The F/O acknowledged. The power levers moved forward progressively to 62 degrees.

At 0542:16 hours the F/O said that he was in sight of the runway. The PIC proceeded to ask the F/O, “where is the runway”? The F/O replied: “ Look below at mine 12 o’clock but the rain is obstructing”.



At 0542:54 the aircraft was at 4,500ft (Selected Altitude). The PIC instructed the F/O “ Lets go a bit lower”. This was followed by the selection of - 400 feet per minute vertical speed (descent) and 4,000 feet altitude.

At 0542:59, around 900ft Radio Altitude (RA) and at approximately 1.5 Nautical Miles (NM) from the runway threshold, the PIC said he had the runway in sight and he took control from the F/O. At 0543:01 hours the autopilot was disengaged. Power levers were moved backwards to 38 degrees (flight idle position)

At 0543:07 hours the pilot control column effort was above 10 daN³ in nose down direction (one point recorded) and the Vertical speed was -1,100 ft/min. Distance from runway threshold was

³ Only effort on the control column above 10daN is recorded on the FDR

estimated to be 2.26 km (1.2 nm). The aircraft RA was 878 ft. The pitch angle of the airplane continued to decrease while the rate of descent increased to 1,700 ft/min.

At 0543:09 hours the PIC told the F/O "Watch height" and the F/O replied "Ok". At this point the wind speed was reported by the F/O to vary from 19 kt to 28 kt (33 kph to 52 kph). The wind direction recorded by the Flight Data Recorder (FDR) was approximately 30 degrees.

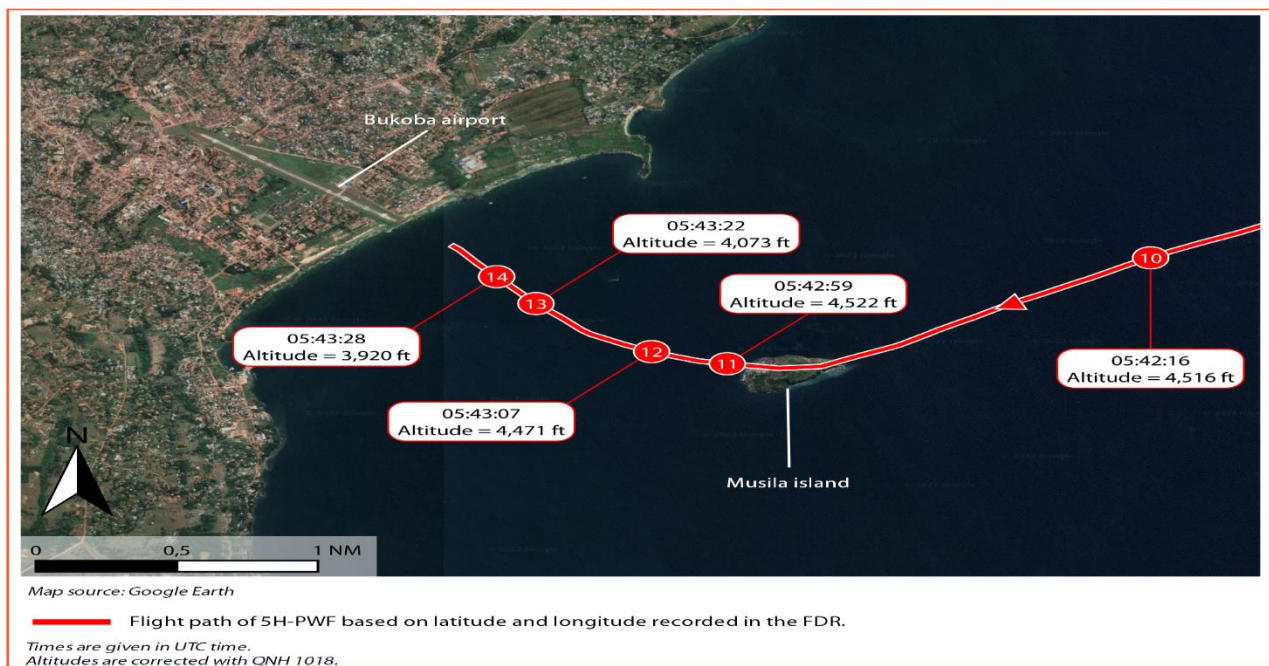
At 0543:20 hours there was a radio altimeter 500 feet call out. Some 2 seconds later there was an EGPWS warning: SINK RATE, SINK RATE, whilst the vertical speed was 1,700 ft/min, wind speed 25 kt (46 kph) and direction 32 degrees.

At 0543:26 hours the PIC instructed the F/O to put the condition lever to maximum. The pilot control column registered effort above 10 daN in nose down direction (one point recorded), vertical speed -1,300 ft/min and the distance to runway 31 threshold was estimated to be 1.11 km (0.60 nm). The aircraft Radio Altitude was 300 ft.

At 0543:28 hours there was an EGPWS warning SINK RATE and one second later, there was a pilot control column effort above 10 daN in nose down direction (four points recorded). Five seconds later there was another SINK RATE warning and the rate of descent increased to 1,700 ft/min.

At 0543:35 hours the F/O called: "Lift up Captain". One second later, there was a SINK RATE PULL UP warning from the EGPWS. The rate of descent decreased to 1,500 ft/min. There was no response from the PIC.

At 0543:38 the F/O shouted: "Pull up captain" and the aircraft impacted the water. The impact with water occurred at this time while the aircraft was descending at 1,500 feet per minute and the DFDR recorded pilot control column effort of above 10 daN in the nose up direction. This was the last point recorded by the flight data recorder.



The aircraft collided with water in a 2 degrees nose down attitude banking 10 degrees to the left.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	2	17	0
Serious	0	0	0
Minor	1	0	0
None	1	22	0

1.3 Damage to aircraft

The aircraft was substantially damaged by impact with water and sustained more damage during recovery to the shore. It has since been declared written off.



1.4 Other damage

There was no third party damage.

1.5 Personnel information

1.5.1 Pilot in command

The captain, age 64, held an Airline Transport Pilot Licence (ATPL) with type rating for ATR 42/72 airplanes issued on 04th August 2010. He had a valid medical certificate class I until 04th January 2023. At the time of the accident, the captain had accumulated about 23,515 hours of total flying time, of which 11,919 hours were as pilot-in-command (PIC) on the type. In the 28 days, 7 days, and 24 hours before the accident, the captain had accumulated a total of 29.80 hours, 13.17 hours, and about 03.85 hours of flying time respectively. His last simulator training was held on 16 October 2022. He scored the highest rating in all safety related aspects including CRM skills and general conduct, situational awareness and sink rate warning response.

Also, he was the Chief Pilot, a company Instructor and Examiner.

1.5.2 Co - Pilot

The Co-pilot, age 46, held Commercial Pilot Licence (CPL) with type rating for ATR 42/72 airplanes issued on 01st November 2018. He had a valid medical certificate class I until 23rd April 2023.

At the time of the accident, the co-pilot had accumulated 2,109 hours of total flying time, of which 1,700 hours were on the type. In the 28 days, 7 days, and 24 hours before the accident, the co-pilot had accumulated a total of 74.01 hours, 23.47 hours, and about 03.05 hours of flying time, respectively.

1.6 Aircraft information

1.6.1 General

The aircraft type and model (ATR 42-500) was mainly produced for regional flights by the joint venture between the French company (Aérospatiale, now Airbus) and its Italian partner (Aeritalia, now Leonardo). It is a high-wing aircraft with retractable landing gear. The ATR 42-500 is powered by two Pratt & Whitney Canada turboprop engines (PW 127M).

1.6.2 Certification

European Aviation Safety Agency (EASA) Type certificate for the said aircraft was issued on 28 July 1995 to ATR-GIE Avions de Transport Regional of France. The accident aircraft, serial number MSN 819 was manufactured at Toulouse, France in 2010. It was subsequently registered on 25th August 2010 in Tanzania and Certificate of Airworthiness (C o A) was issued on 26th August 2010. At the time of accident, the Certificate of Airworthiness validity was up to 13th January 2023. The aircraft had been operated under the Air Operator Certificate (AOC) of Precision Air.

1.6.3 Status

At the time of the accident, the aircraft had accumulated 16,893.22 total flight hours with 16,610 total flight cycles. The left and right engines had accumulated 22,811.07 and 21,193.42 hours respectively. The last Certificate of Release to Service (CRS) was issued on 02nd September 2022 at airframe hours 16,265.47 and cycles 16,016 during the '12YE' + '1A' check. At the time of the accident, it was still valid up to 16th January 2023.

1.6.4 Loading and C of G disposition

A review of weight and balance and loading information for the accident flight revealed the aircraft was within weight and centre-of-gravity limits. The passengers and cargo were loaded within the structural limitations for each respective compartment. The accident aircraft's take-off weight was 18.236 tonnes. (The maximum certificated take-off weight is 18.6 tonnes according to its Type Certificate Data Sheet)

1.7 Meteorological information

The Weather information at Bukoba Airport at 0400 hours (0700 hours local Time) and 0500 hours (0800 Local Time) was transmitted from Bukoba MET Office to Mwanza Approach through Meteorological Aviation Information System and the weather was as follows:

METAR HTBU 060400Z 27005KT 9999 SCT010 FEW012CB BKN080 20/17 Q1017=

METAR HTBU 060500Z 00000KT 9999 SCT011 FEW013CB BKN080 20/17 Q1018=

At 0520 hrs (0820 hours Local Time) the weather had changed drastically and SPECI HTBU 060520Z 33010KT 2000 BKN010 FEW012CB OVC080 20/17 Q1019= was transmitted to Mwanza Approach at 0523:14 hrs.

However, according to the MET officer at Bukoba airport, when the weather changed, information was transmitted to Mwanza Approach advising that the aircraft should wait for the weather to normalise before deciding to land at Bukoba airport.

Despite being transmitted to Mwanza Approach on (frequency 122.8), Mwanza Approach were unable to contact the crew to notify them of SPECI weather alert since they had already changed frequency to 118.2 which is the unmanned frequency for approach and landing at Bukoba airport. The record of weather observation by Bukoba MET after the accident was as follows:

METAR HTBU 060700Z 24005KT 8000 -RA SCT012 FEW014CB BKN080 20/19 Q1019 =

1.8 Aids to Navigation and Communications

At the time of the accident there was no Instrument Flight Rules (IFR) approach procedure available at Bukoba airport hence only Visual Flight Rules (VFR) approaches were being carried out for all aircraft operating into that airport. All aircraft operating into the airport use the services of Mwanza Approach on frequency **122.8 MHz** until they report Bukoba insight. Subsequently the flight crew switch from the said frequency to **118.2 MHz** which is the unmanned frequency for approach and landing at Bukoba.

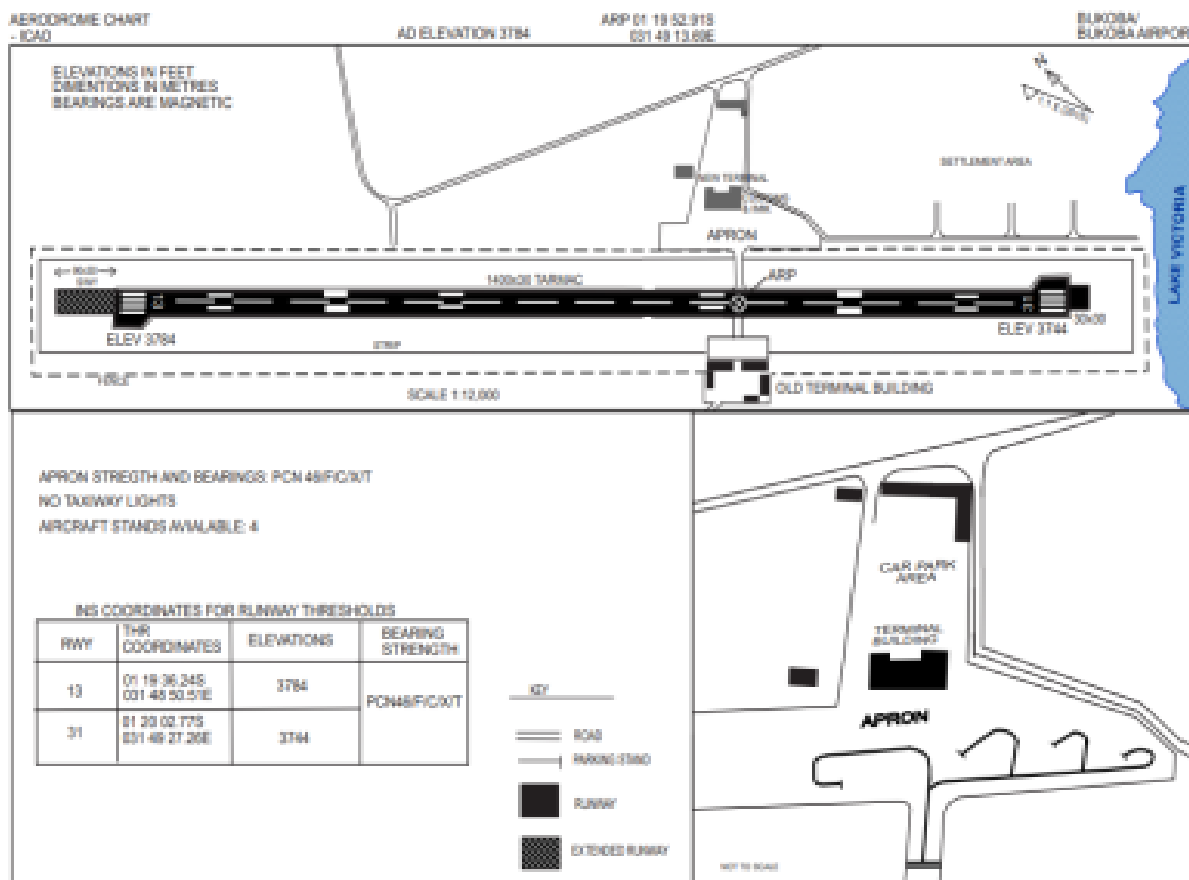
It is common practice for operators with aircraft flying from Mwanza to contact their agents or friends at Bukoba airport by mobile phone asking whether the weather is good for landing. For the layman, Musila island is normally a yardstick. If the island is visible from the Airport terminal building then it is considered good for landing. (Musila island is only 2.8 km from the threshold of runway 31). The required minimum visibility is 5 km and cloud ceiling of 5300 ft.

1.9 Aerodrome information

Bukoba airport has one paved runway surface which is 1,440 meters long and 30 meters wide, at an elevation of 3,740 above sea level. The runway is designated as runways 13 from the mountains and 31 from the lake. The paved surface was in good condition at the time of the accident.

There is a fire station at Bukoba airport which is equipped with one fire engine and manned by 10 fire men who provide rescue operations on land occurrences. At the time of the accident, the Bukoba Fire Station was not equipped for offshore operations.

Water rescue operations for Bukoba was the responsibility of the Police Marine unit at the nearby Bukoba marine port which was also responsible for conducting Marine Patrols in Lake Victoria.



Bukoba Airport

Pilots who frequently fly into Bukoba reported that the approach to the airport can be tricky in adverse weather conditions. The runway is short with obstacles in both directions. There is Musila Island with a 36 meters tall cliff located 2.8 km away along the path to the threshold of runway 31. There are also tall hills rising to 560 feet above the elevation of the airport in the approach path of runway 13. During rainy season at Bukoba it is usual to experience abrupt changes in weather conditions, sometimes lasting a good fraction of an hour which creates severe turbulence above the lake surface especially near the shores. Wind shear has also been reported by pilots flying into this airport.

1.10 Flight recorders

1.10.1 The Aircraft was equipped with a Cockpit Voice Recorder (CVR) and a Flight Data Recorder (DFDR) as required by the current Civil Aviation (Instruments and Equipment) regulations. At the time of the occurrence both recorders were serviceable.

Both recorders were recovered from the wreckage and examined at the BEA, Le Bourget, France. Downloading and analysis was performed by the experts from BEA with the presence of the Tanzania AAIB investigation team.



CVR



DFDR

1.10.2 Cockpit Voice Recorder (CVR)

The aircraft was equipped with a solid state L3 Harris FA2100 CVR, P/N 2100-1020-02, S/N 734631 which is capable of recording 120 minutes of high quality 4-channelled audio data. The CVR records the cockpit area microphone, captain's microphone, first officer's microphone and all received transmission on the aircraft's selected communication radio including the intercom.

The data from the CVR was recovered successfully and the quality of recording was good.

1.10.3 Flight Data Recorder (FDR)

The aircraft was equipped with a L3 Harris FA2100 DFDR, P/N 2100-4043-00, S/N 167754 capable of recording at least 25 flight hours essential parameters. Around 109 hours of flight data parameters with quality and precision were retrieved, including of the accident flight.

1.11 Wreckage and impact information

Examination of the wreckage showed that the left wing tip was the first to hit the water surface followed by the nose and the left main landing gear. This appears to be reason for the separation of the left wing tip, the radome, the nose landing gear and the left main landing gear which in turn ripped open part of the main floor allowing water to flood the cabin.

The left wing impacted water at landing speed causing the aircraft to swing left in a circle before settling on water facing the opposite direction. The forward fuselage section which was flooded by water sunk below the water line.

The aircraft came to rest in water (Lake Victoria) some 500 meters from the threshold of runway 31 and 385 meters from the shore line. The depth of water at this point was 5.4 meters (18 feet). It was inclined at a shallow angle to the horizontal with much of the front section of the fuselage completely immersed in water. Only the aft section of the fuselage and the tail plane were clear of the water. The rear passenger door on the left side of the fuselage was partially submerged in water.

The damage to the aircraft was consistent with high energy impact with water. The assessment was done after the removal of the wreckage from water, therefore other damages were associated with the recovering exercise.

1.11.1 Fuselage

The nose and forward fuselage sections were significantly damaged whereas the aft section suffered minor damage. The radome was found completely separated from the fuselage.

The frame 1 bulkhead, the stiffeners and the Nose Landing Gear (NLG) bay were found severely deformed, buckled and fractured, consistent with heavy impact damage. The underneath section of the fuselage was significantly damaged, deformed and detached with broken belly fairing panels. Also wrinkled frames and aircraft skin were detached from the fuselage.

The floor panels and associated structures were heavily damaged. The skin was completely torn and the fuselage was almost separated between frame number 13 and 23.



1.11.2 Engines

The engine No.1 appeared to be in fairly good external general condition, however, the inboard shock mount showed an impact mark while the outboard shock mount did not show any damage. The chip detectors were removed and no contamination was observed.

The engine No. 2 also appeared to be in a fairly good external general condition with no signs of damage on the shock mounts. The forward chip detector was removed and no contamination was observed.

Oil samples and Electronic Engine and Propeller Control modules were taken from both engines for further analysis. However, it later became unnecessary to carry out this analysis because the engines were not relevant to the circumstances of the accident.

1.11.3 Propeller

The Left Hand propeller was significantly damaged and all 6 blades were broken at around two-third of their lengths. The blade pitches were found close to the feather positions and they could not be rotated around their pitch positions. However, the propeller assembly was free to rotate when moved by hand.

The Right Hand propeller was found slightly damaged and the six blades were almost intact.

Two blade tips were missing, one blade end section was bent aftward and two blade tips were damaged, with a small portion missing. The blade pitch was found around half-course position for all blades. When moved by hand, the blades could not be rotated around their pitch positions. However the propeller assembly was free to rotate when moved by hand.

1.11.4 Wings

The left wing was broken, wing tip separated, ruptured wing root at both the leading and trailing edges. The right wing was found complete however it was damaged at the leading and trailing edges. Most of damage on the wing was attributable to the recovery operations as the wreckage was lifted using a crane and cables around the wing roots and empennage section, except for the left wing tip which probably broke when the aircraft impacted the water.

1.11.5 Doors

The passenger door (aft left section) was found open and relatively in a good condition. The closing spring mechanism was found detached from its attachment and its surrounding showing damage in the aft bottom and top corner. The service door was found closed with minor damage at the aft

bottom and top corner. The damage to this door seems to have occurred in the process of wreckage recovery.

The left and right hand emergency exit doors were opened from inside and were found outside of the aircraft with minor damage. There were missing furnishing panels on the left hand emergency door.

The cockpit emergency hatch door was found separated outside of the aircraft and in good condition.

1.11.6 Landing Gear System

The right hand Main Landing Gear was found in extended position and still attached to the aircraft structure. The left Main Landing Gear was found separated from the aircraft, fractured at the middle of the upper leg and a deformed extension/retraction actuator.

The Nose Landing Gear assembly was separated from its main fittings but still attached to the actuator link. The connection with the drag brace was broken.



1.11.7 Flight Controls

The Right Hand aileron was still in place on the wing and showed no visible damage from the ground. Due to lack of access, the aileron movement function could not be performed. The left hand aileron was broken into two parts and separated from the left hand wing.

The elevators were in good condition, as seen from the ground and the right hand trim tab was intact while the left hand trim tab was damaged.

The rudder was severely damaged at the bottom closing rib and generally it sustained minor damage on the skin and associated structures. Most of damages on the rudder were attributable to the recovery operations as the wreckage was lifted using a crane and cables. The damper was still active and free to move.

1.11.8 Cabin

Cabin floor from seat row number 7 forward was significantly damaged, distorted and several passengers seats were partially or completely detached consistent with high energy impact with water.

Forward cabin crew seat was in place but the aft cabin crew seat had been completely detached from the floor and was found outside the wreckage.



1.12 Medical and pathological information

The ICAO medical pathological and toxicological examination of the accident victims were not performed.

The doctor who attended the victims at the Bukoba Government Hospital reported that all bodies recovered from the wreckage showed signs of death by suffocation. This would imply that they all died by drowning. However, none of the survivors sustained serious injuries.

1.13 Fire

There was no fire.

1.14 Survival aspects

No search of aircraft was conducted as the accident occurred about 500 metres from the threshold of runway 31 and it was visible to the fishermen who were on the lake at the time of the occurrence. Similarly, the firefighting unit and AVSEC screeners who were on duty at Bukoba airport heard a loud bang and immediately rushed to the accident scene.

After the impact the forward cabin area was immediately filled with water. The front section of the fuselage was completely immersed in water after the aircraft came to rest while the rear section remained partially immersed in water. Many occupants on the front and middle seats who did not unbuckle themselves immediately were engulfed in water and may have suffocated by drowning.

One of the survivors (seat No. 8) testified that after impact the forward passenger cabin area was immediately filled with water. She untied the seat belt, jumped over the seats and moved to the rear section of the passenger cabin. She was helped to get out of the aircraft by a person whom she could not identify. Another witness (passenger seat number 5) testified that he managed to swim towards an opening just at the front side of the wing attachment, pulled himself, got out of the aircraft. He was then rescued by fishermen.

The cabin crew member who sat on the rear cabin seat testified that after impact she found herself in the mid-passenger cabin section with her detached seat. She untied the safety belt, pulled and grabbed a lifejacket and started wearing it while rushing to the passenger door located at the aft left side section. She unlocked and pushed the door into an open position with assistance from a male passenger.

The cabin crew member who was at the forward station testified that after the impact the cabin was immediately filled with water and it was totally dark in the cabin. She managed to reach one of the cabin emergency doors, opened it and swam out where the fishermen rescued her out of the water.

Most of the survivors evacuated the aircraft wreckage through the rear passenger door. These surviving passengers including a child of 18 months as well as its mother were also saved in this way. Canoes and fishermen arrived after about 5 minutes and they transferred the survivors to their boats. 24 survivors including the two cabin crew members were saved. The survivors were brought ashore by fishermen boats which arrived at the accident site soon after the accident.

The official rescue marine boat belonging to the Police Marine Unit arrived at 1049 hours (1349 hours local time) and joined the evacuation operation. The reason for late arrival to the accident scene was that it was on patrol duties outside Bukoba port.

Before the arrival of the Police Marine Unit, one of the local fishermen who had his own oxygen equipment, started the process of recovering the dead bodies from the wreckage.

Mid and forward passenger cabin sections were significantly damaged with detached seats and other cabin structures consistent with high energy impact with water. Some seats and floor panels forward of row 7 were completely detached which might have significantly affected the evacuation of other passengers and flight crew. Further significant damage to this area was generated during the aircraft recovery phase.

1.15 Tests and research

No test and research was conducted.

1.16 Organizational and management information

1.16.1 Aircraft Operator

Precision Air Service Plc is a company registered and incorporated under the laws of the United Republic of Tanzania in January 1991 as a private airline and started operations in 1993 as a private charter air transport company. In November 1993 it changed and started scheduled commercial air transport operations.

At the time of the accident the airline had been issued with an Air Service Licence (ASL) and Air Operator Certificate (AOC) number CAA/AOC/03 (valid until 31 December 2022) to conduct scheduled commercial air transport operation within Tanzania and in adjacent States. The airline also held an Approved Maintenance Organization (AMO) certificate number TCAA/AMO/1.97 (valid until 19 January 2023) with a capability to perform base maintenance and line maintenance on ATR 42 and ATR 72 aircraft. Both certificates have since been renewed and they are currently valid. The principal base of operations is at Julius Nyrere International Airport (JNIA), Dar es Salaam, Tanzania. Precision Air maintenance hangar is located adjacent to Terminal One JNIA.

The operator had a fleet of nine (9) registered aircraft (five ATR-72-212A (-500 version), two ATR 42-500 and two ATR 42-600). Out of nine aircraft, the operator has a fleet of seven (7) aircraft listed in the AOC Operation Specification (OPS SPEC). On the day of occurrence four (4) aircraft were serviceable and in operations including the accident aircraft. The remaining three (3) were on ground undergoing various stages of maintenance checks.

1.17 Aircraft Recovery Operations

The aircraft came to rest in water some 385 meters from the shoreline and 500 meters from threshold of runway 31. Initially the wreckage was pulled by using ropes tied to the wing root and empennage section to a position nearer to the lake shore. Later the wreckage was lifted out of water using a crane and moved to a grass field within the airport compound.

1.18 Useful or effective investigation techniques

The investigation of the accident was carried out in accordance with ICAO Annex 13 to The Chicago Convention on International Civil Aviation and in compliance with the Tanzania Civil Aviation (Aircraft Accident and Incident Investigation), Regulations, 2017.

2 ANALYSIS

2.1 Conduct of the flight

The circumstances of the accident show that towards the end of the flight, the flight crew encountered poor weather conditions which had not been expected at the commencement of the flight. As there is no Air Traffic Services at Bukoba, the crew could not get weather update while on the unmanned frequency (118.2 MHz). In any case, abrupt changes in weather conditions both enroute and around destination airports in the Lake Region are common especially during the month of November.

The weather was good for almost the entire flight but it changed into rain and violent thunderstorms with lightning and Cumulonimbus (CBs) when the aircraft was only five minutes from the destination airport. There was also a significant cross wind.

This type of weather is common around Bukoba airport and is well known to pilots. Many pilots often choose to divert to Mwanza or climb to a safe altitude and circle around until the weather improves. It is evident that the flight crew for 5H-PWF encountered bad weather at Bukoba and chose the later option. The flight circled around for about 15 minutes in heavy rain and limited visibility.

At one point the EGPWS warnings (against terrain) came on but was not heeded. Although the flight was IFR the crew was flying the aircraft under Visual Meteorological Conditions which probably made them to consider the warning as cautionary.

2.2 The weather

The aircraft had been circling around the west of the airport hoping that the weather would improve. At the time of the final approach the weather had not improved sufficiently to allow clear visibility around the runway. Marginal visibility caused high workload among the flight crew and may have contributed to the failure to react to terrain warnings.

2.3 Crew resource management

There was a discussion among the two pilots as they encountered bad weather at Bukoba. They together decided that it was prudent to land on runway 13 (From the mountain) instead of using runway 31 (From the lake). This was because of the well known fact that the weather tends to be more active over the lake than over land masses.

The F/O twice advised the PIC to divert to Mwanza but the PIC chose to continue with attempts to land at Bukoba.

Towards the end of the flight there was a period of about 15 seconds during which the EGPWS SINK RATE warning was triggered and the F/O shouted to the PIC “pull up” without response. The PIC only started pulling up when the aircraft was too close to impact at the vertical speed of 1,500 feet per minute. It is considered that during this time the PIC had already lost situational awareness. According the Flight Manual, in the landing configuration, when a PULL UP warning is triggered, a correct response is to initiate a go around immediately when the source of the warning is not known while if the SINK RATE warning is triggered the response is to increase pitch and power to make the warning cease. Refer Appendix 1.

3 CONCLUSION

3.1 Findings

On the basis of the information gathered during the course of the investigation, the following facts have been determined:

- i. The flight crew were correctly licenced and qualified to conduct the flight;
- ii. The aircraft had valid Registration, Airworthiness and Release to Service Certificates as well as the completed required scheduled maintenance;
- iii. At the time of arrival at Bukoba Airport, visibility was limited and there was heavy rain with thunderstorms, CBs and lightning;
- iv. The flight crew chose to circle around for some time hoping that the weather at Bukoba would improve sufficiently to allow a visual approach and landing;
- v. After 15 minutes of circling around, visibility had not improved to the required minimum of 5 km and cloud ceiling of 5300 ft;
- vi. The final approach was conducted in conditions of poor visibility;
- vii. There was an EGPWS SINK RATE warning during the final approach but the PIC pushed the control column to nose down instead of doing the opposite;
- viii. The flight crew were coping with gusting cross wind, poor visibility, rain and turbulence by the time the aircraft struck the lake Victoria water surface;
- ix. The aircraft was not stabilised during the final approach;
- x. The aircraft struck the surface of the lake in a left wing low and nose down attitude
- xi. The damage to the aircraft was consistent with high energy impact;
- xii. The aircraft flight control responses were consistent with the flight crew inputs; and
- xiii. At the time of the accident there was no published procedure for approach and landing at Bukoba airport.

3.2 Causal factor

The accident was caused by an unstabilized final approach to runway 31 of Bukoba airport conducted in poor weather conditions which did not allow clear sight of the terrain. This led the aircraft to strike the water on the lake surface.

3.3 Contributory factors

The major contributory factors were:

- i. The decision of the Pilot in Command to proceed with the final approach without the required weather minima in order to reach the runway instead of diverting to Mwanza;
- ii. The gusting crosswind which prevailed at the time of final approach;
- iii. The heavy rain and turbulence at that material time
- iv. The absence of air traffic services at Bukoba Airport
- v. High rate of descent at low altitude
- vi. No immediate response to the EGPWS warnings
- vii. High work load to the crew at the critical phase of final approach

4 SAFETY RECOMMENDATIONS

It is recommended that:

- i. TCAA should ensure that PBN procedures (IFR Approaches) are developed and published for all VFR airports which have scheduled commercial flights;
- ii. TCAA should ensure that Air Traffic Services are established at Bukoba Airport;
- iii. Precision Air Services PLC shall comply with the regulatory requirements governing minimum limitations (Operating weather minima) and conform to the procedures as stated in their SOPs;
- iv. Precision Air Services PLC and other operators should always stick to weather information supplied by official sources;
- v. Tanzania Airport Authority (TAA) should ensure that Bukoba Rescue and Fire Fighting Services (RFFS) is strengthened by including water rescue capability;
- vi. Ministry of Health should ensure that qualified medical doctors are available to conduct autopsy in accordance with ICAO Standards and Recommended Practices;
- vii. Precision Air Services PLC should implement flight data monitoring procedures to support SOP ; and

- viii. Air Navigation Service Provider at Mwanza airport should amend the relevant procedures to include provisions to transmit critical weather information to aircraft that has already tuned their radios to the unmanned frequency (118.2 MHz).

5 SAFETY ACTIONS

- 5.1 Following this accident a PBN procedure was developed and published for Bukoba airport
- 5.2 The weather reports at Bukoba are being transmitted twice every hour to Mwanza Approach.

APPENDIX I

GPWS – TAWS WARNING

ABS.2 GPWS – TAWS WARNING

ABS.2.1 GPWS - TAWS Warning

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NEW

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Note

When flying under daylight VMC conditions, should a warning threshold be deliberately exceeded or encountered due to known specific terrain at certain locations, the warning can be regarded as cautionary and the approach can be continued.

A go-around shall be initiated in case warning cause cannot be identified immediately.

“PULL UP” or “TERRAIN TERRAIN” or “TOO LOW TERRAIN”

■ If in landing configuration

- ▶ GO AROUND..... PERFORM

Note

Advance PLs to the Wall if necessary.

■ If not in landing configuration

- ▶ APOFF
- ▶ CLIMBINITIATE WITH CURRENT IAS
- ▶ MAX POWER.....APPLY AS RQRD

Note

Advance PLs to the Ramp, or to the Wall if necessary.

- ▶ PWR MGT..... MCT
- ▶ AIRCRAFT CONFIGURATIONMAINTAIN
- ▶ IASADJUST TO BEST CLIMB GRADIENT SPEED

BEST CLIMB GRADIENT SPEED		
CONF	NORM	ICING
Flaps 0 °	White Bug	Red Bug
Flaps 15 °	White Bug -10 kt	White Bug
Flaps 25 °	V _{GA}	V _{GA}

cont'd... >>>

Note

When workload permits, retract landing gear if extended.

- **When flight path is safe and GPWS warning stops**
Resume normal flight

"SINK RATE"

Increase pitch and power to make the warning cease.

"DON'T SINK"

Adjust pitch attitude and power to maintain level or climbing flight.

"TOO LOW GEAR" or "TOO LOW FLAPS"

Correct the configuration or perform a go-around.

"GLIDE SLOPE"

- Establish the aircraft on the glide slope, or
- Press one GPWS/GS pb if flight below glide slope is intentional (non precision approach).

"BANK ANGLE"

Decrease bank angle.

Enhanced modes :

"TERRAIN AHEAD - TERRAIN AHEAD" or "OBSTACLE AHEAD - OBSTACLE AHEAD"

Verify the aircraft flight path, correct it if required, if in doubt, perform a maximum climb until the caution alert stops.

"TERRAIN AHEAD - PULL UP" or "OBSTACLE AHEAD - PULL UP" or "TOO LOW TERRAIN"

■ **If in landing configuration**

- ▶ GO AROUND..... PERFORM

Note

Advance PLs to the Wall if necessary.

■ **If not in landing configuration**

- ▶ APOFF
- ▶ CLIMBINITIATE WITH CURRENT IAS
- ▶ MAX POWER.....APPLY AS RQRD

REFERENCES

1. The Civil Aviation (Accident and Incident Investigation) Regulations, 2017
2. ICAO Annex 13 – Aircraft Accident Investigation
3. Manual of Aircraft Accident Investigation (DOC9756)
4. Manual of Accident and Incident Investigation Policies and Procedures (DOC9962)
5. BEA Contribution Report on 5H-PWF Accident – Preliminary
6. ATR HFACS Presentation
7. ATR DFDR Factual Report
8. ATR Flight Safety Conference 2023 (Presentation on 5H-PWF)